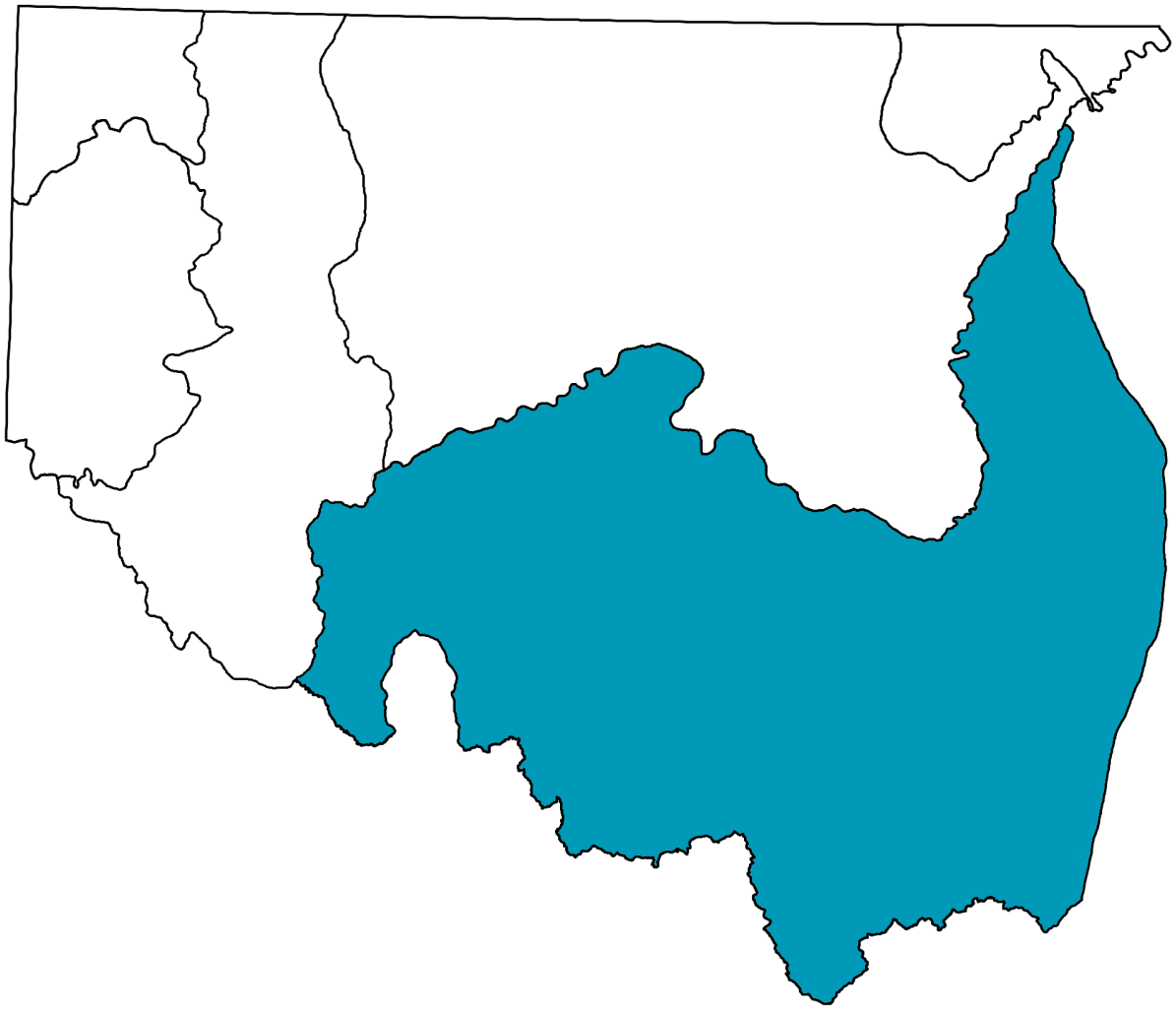
Section 6.1
Coconino Plateau Basin



6.1.1 Geography of the Coconino Plateau Basin

The Coconino Plateau Basin, located in the western part of the planning area is 5,812 square miles in area and the largest basin in the planning area. Geographic features and principal communities are shown on Figure 6.1-1. The basin is characterized by high-elevation mountain ranges, plateaus and canyons. Vegetation types include Mohave and Great Basin desertscrub, plains grasslands, Great Basin conifer woodland and Rocky Mountain montane conifer forest. There are small areas of subalpine conifer forest and alpine tundra in the San Francisco Mountains in the southeast corner of the basin. (See Figure 6.0-9)

- Principal geographic features shown on Figure 6.1-1 are:
    - Principal basin communities of Tusayan and Williams
    - Other communities and places of Bitter Springs, Desert View, Cameron, Grand Canyon, Rose Well, Supai, The Gap and Valle
    - The Colorado River and Grand Canyon forming the northern basin boundary
    - Numerous streams that flow into the Colorado River including Diamond Creek, Havasu Creek and the Little Colorado River
    - Coconino Plateau in the center of the basin
    - Aubrey Cliffs in the eastern portion of the basin
    - San Francisco Peaks in the southeastern portion of the basin, including the highest peak in the basin and planning area, Mt. Humphries at 12,633 feet.

Base Map: USGS 1:500,000, 1981

Figure 6.1-1
Coconino Plateau Basin
Geographic Features

6.1.2 Land Ownership in the Coconino Plateau Basin

Land ownership, including the percentage of ownership by category, for the Coconino Plateau Basin is shown in Figure 6.1-2. Principal features of land ownership in this basin are the large blocks of tribal lands and the checkerboard pattern of state trust and private land. A description of land ownership data sources and methods is found in Volume 1, Section 1.3.8. Land ownership categories are discussed below in the order of percentage from largest to smallest in the basin.

Indian Reservation

- 37.3% of the land is under tribal ownership.
- The basin includes all or parts of three reservations; the Hualapai Indian Reservation, the entire Havasupai Indian Reservation and the Navajo Indian Reservation.
- This basin contains the largest percentage of tribal lands in the planning area.
- Land uses include domestic, commercial, recreation and ranching.

Private

- 22.0% of the land is private.
- The majority of the private land is in the center of the basin and is interspersed with state trust lands.
- Land uses include domestic, commercial and ranching.

National Forest and Wilderness

- 17.8% of the land is federally owned and managed as National Forest and Wilderness.
- Forest lands in the basin are part of the Kaibab and Coconino National Forests.
- The basin contains approximately 25,000 acres in two wilderness areas, Kendrick Mountain in the Coconino and Kaibab National Forests and Kachina Peaks in the Coconino National Forest.
- Land uses include recreation, grazing and timber production.

State Trust Land

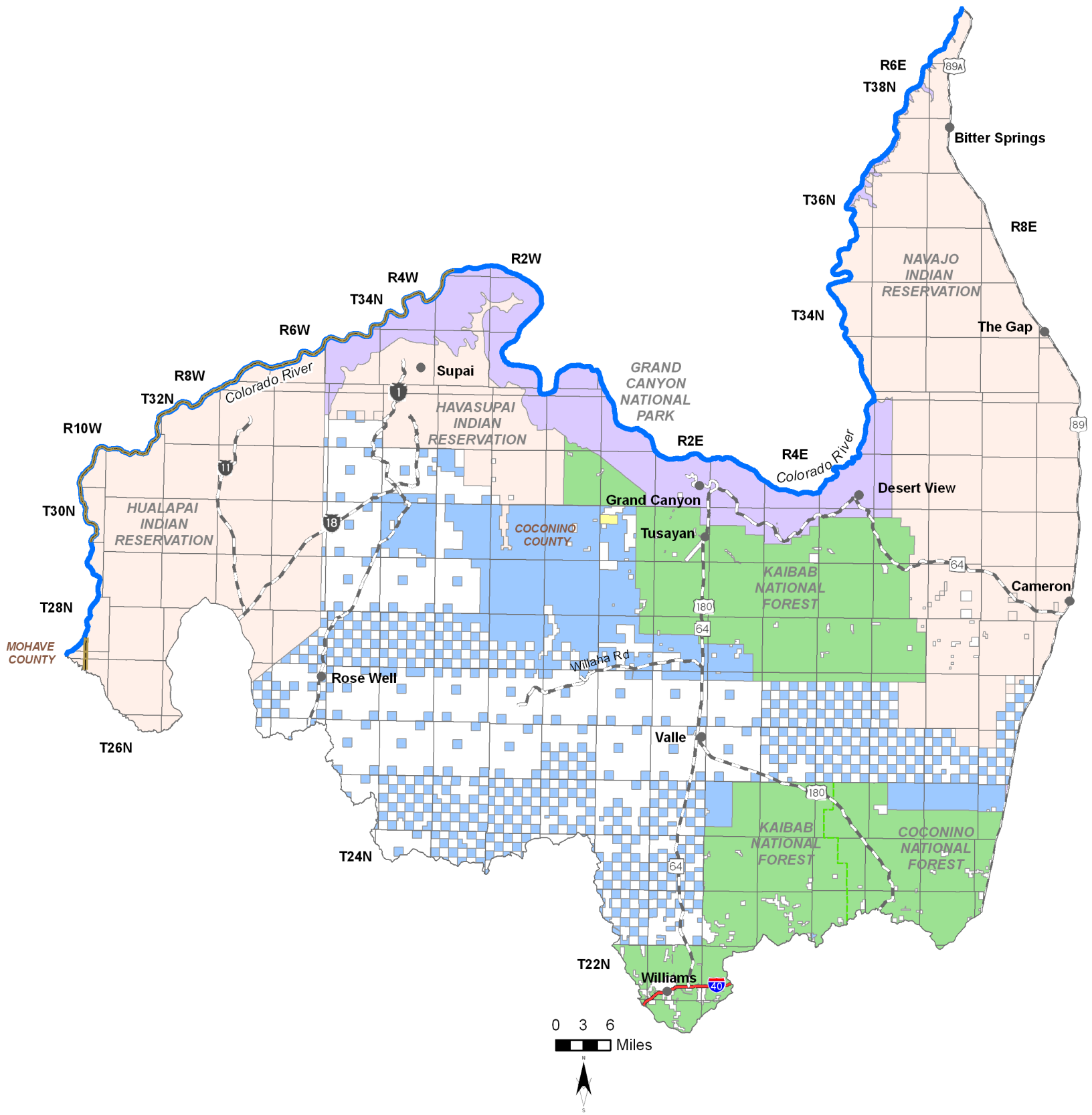
- 15.4% of the land is held in trust for the public schools and seven other beneficiaries under the State Trust Land system.
- Most state land is located in the center of the basin interspersed in a checkerboard pattern with private land.
- Primary land use is grazing.

National Park Service (NPS)

- 7.4% of the land is of the land is federally owned and managed by the National Park Service as the Grand Canyon National Park.
- Land uses include resource conservation and recreation.

U.S. Bureau of Land Management (BLM)

- 0.1% of the land is federally owned and managed by the Hassayampa Field Office of the Bureau of Land Management.
- The small portion of BLM land is southwest of the Grand Canyon.
- Primary land use is grazing.



Source: ALRIS, 2004
Bureau of Land management, 1999

Land Ownership (Percentage in Basin)

Indian Reservation	(37.3%)
Private	(22.0%)
National Forest & Wilderness	(17.8%)
State Trust	(15.4%)
National Park Service	(7.4%)
U.S. Bureau of Land Management	(0.1%)

National Forest Boundary
COUNTY
Interstate Highway
Major Road
City, Town or Place

Figure 6.1-2
Coconino Plateau Basin
Land Ownership

6.1.3 Climate of the Coconino Plateau Basin

Climate data from NOAA/NWS Co-op Network, Evaporation Pan and SNOTEL/ Snowcourse stations are complied in Table 6.1-1 and the locations are shown on Figure 6.1-3. Figure 6.1-3 also shows precipitation contour data from the Spatial Climate Analysis Service (SCAS) at Oregon State University. The Coconino Plateau Basin does not contain AZMET stations. A description of the climate data sources and methods is found in Volume 1, Section 1.3.3.

NOAA/NWS Co-op Network

- Refer to Table 6.1-1A
- Temperatures at the five NOAA/NWS Co-op Network stations range from an average annual high of 83.0°F at Supai to an average annual low of 29.3°F at Grand Canyon National Park.
- All stations report highest average seasonal rainfall in the summer season (July-September) when about 32% of the annual rainfall occurs.
- The highest average annual precipitation is 21.37 inches at Williams and the lowest average annual precipitation is 8.76 inches at Supai.

Evaporation Pan

- Refer to Table 6.1-1B
- There is one evaporation pan station in the basin, Grand Canyon National Park 2. This pan is at 6,790 feet and has an annual evaporation rate of 44.04 inches.

SNOTEL/Snowcourse

- Refer to Table 6.1-1D
- There are four SNOTEL/Snowcourse stations in the basin, one at the Grand Canyon and the others located in the San Francisco Peaks area.
- The highest average monthly snowpack at most stations is in April.

SCAS Precipitation Data

- See Figure 6.1-3
- Additional precipitation data shows average annual rainfall as high as 40 inches at the southeastern tip of the basin and as low as four inches along the Colorado River.

Table 6.1-1 Climate Data for the Coconino Plateau Basin

A. NOAA/NWS Co-op Network:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Temperature Range (in F)		Average Precipitation (in inches)				
			Max/Month	Min/Month	Winter	Spring	Summer	Fall	Annual
Grand Canyon N.P.	6,890	1971-2000	69.2/Jul	29.3/Jan	4.38	1.92	5.73	3.65	15.68
Grand Canyon N.P. 2	6,970	1971-2000	67.0/Jul	30.4/Jan	5.20	2.17	5.40	3.73	16.50
Grand Canyon N.P. 3	6,960	1957-1977[1]	69.0/Jul	30.5/Jan	2.92	1.84	3.89	3.87	12.51
Supai	3,200	1956-1987[1]	83.0/Jul	40.7/Jan	2.36	1.20	3.02	2.18	8.76
Williams	6,750	1971-2000	68.3/Jul	33.4/Jan	6.77	2.28	7.28	5.04	21.37

Source: WRCC, 2003
N.P. = National Park
[1] Average temperature for period of record shown; average precipitation from 1971-2000

B. Evaporation Pan:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
Grand Canyon N P. 2	6,790	1976 - 2002	44.04

Source: WRCC, 2003

C. AZMET:

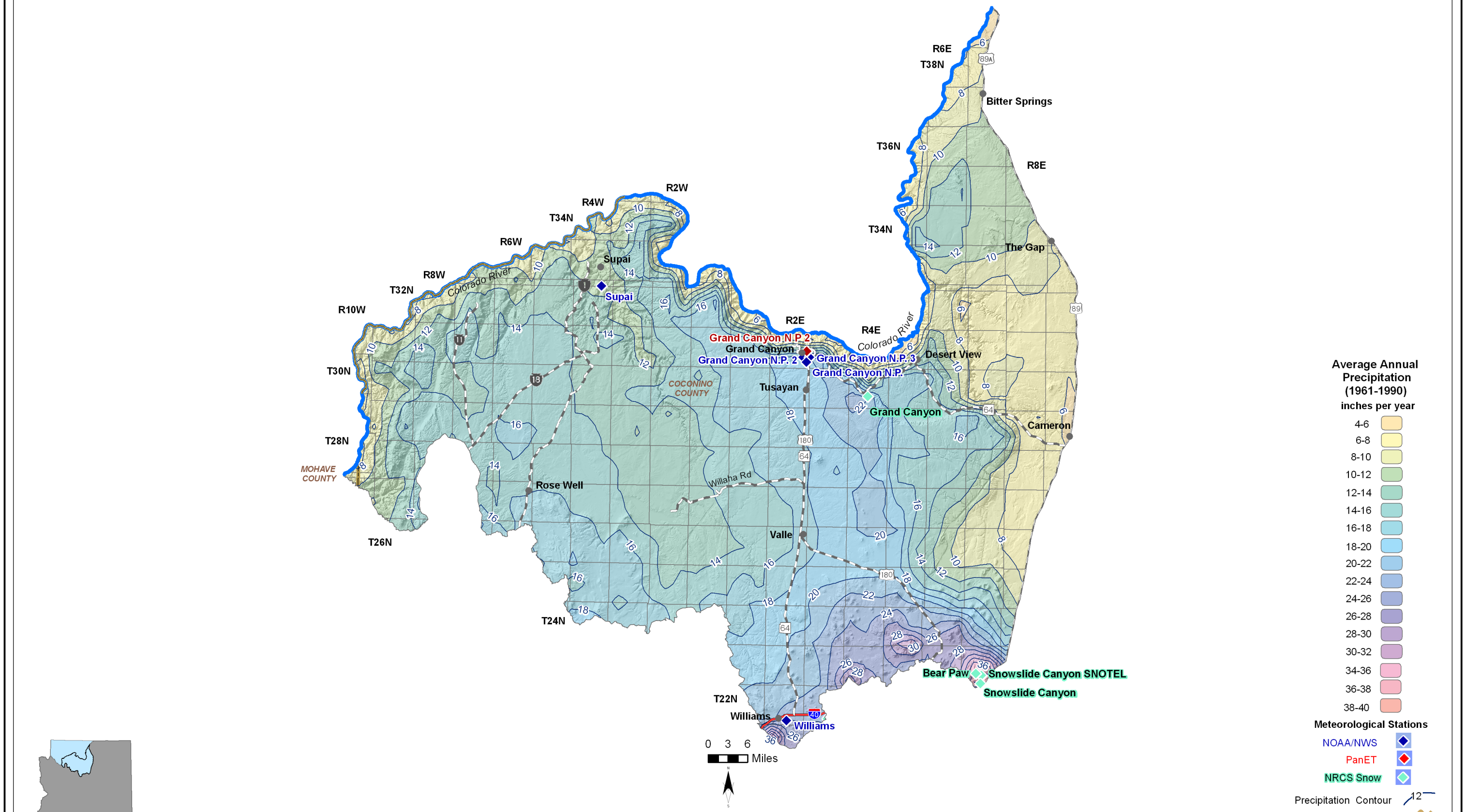
Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Annual Reference Evaportranspiration, in inches (N*umber of years to calculate averages*)
None			

Source: Arizona Meteorological Network, 2005

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Snowpack, as Snow Water Content, at the Beginning of the Month, in Inches *(Number of measurements to calculate average)*					
			Jan.	Feb.	March	April	May	June
Bear Paw	10,100	1968 - current	9.8*(16)*	11.7*(27)*	17.8*(36)*	20.8*(37)*	18.1*(20)*	7.1*(11)*
Grand Canyon	7,500	1947 - current	1.2*(22)*	2.3*(56)*	2.1*(57)*	0.7*(54)*	0*(0)*	0*(0)*
Snowslide Canyon	9,750	1968 - current	6.7*(16)*	9.0*(27)*	13.4*(36)*	15.2*(37)*	9.1*(20)*	0.7*(10)*
Snowslide Canyon (SNOTEL)	9,730	1998 - current	*6.3(7)*	*8.4(7)*	*12.6(7)*	*14.0(7)*	*8.7(7)*	0*(7)*

Source: NRCS, 2005



Precipitation Data Source: Oregon State University, 1998

Figure 6.1-3
Coconino Plateau Basin
Meteorological Stations and Annual Precipitation

6.1.4 Surface Water Conditions in the Coconino Plateau Basin

Streamflow data, including average seasonal flow, average annual flow and other information are shown in Table 6.1-2. Flood ALERT equipment in the basin is shown in Table 6.1-3. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 6.1-4. The location of streamflow gages identified by USGS number, flood ALERT equipment, USGS runoff contours and large reservoirs are shown on Figure 6.1-5. A description of stream data sources and methods is found in Volume 1, Section 1.3.16. A description of reservoir data sources and methods is found in Volume 1, Section 1.3.11. A description of stockpond data sources and methods is found in Volume 1, Section 1.3.15.

Streamflow Data

- Refer to Table 6.1-2.
- Data from 12 stations located at eight watercourses are shown in the table and on Figure 6.1-5. Six of the 12 stations have been discontinued and four of the six remaining stations are real-time stations.
- Average seasonal flow is relatively similar in all seasons at most stations due to regulated flow on the Colorado River or proximity to springs. Notable exceptions are, Moenkopi Wash near Cameron and Bright Angel Creek near Grand Canyon. Moenkopi Wash reports highest seasonal flow in the summer (July-September) when 78% of the average annual flow occurs and Bright Angel Creek receives highest seasonal flow in the spring (April-June) when 50% of the average annual flow occurs.
- The largest annual flow recorded in the basin is 15.97 million acre feet in 1997 at the Colorado River above Diamond Creek near Peach Springs station with a contributing drainage area of 144,660 square miles.
- All eight streams in this basin have a mean and median annual flow of over 10,000 acre-feet. Two of those eight streams, Little Colorado River and the Colorado River, have a mean annual flow of over 100,000 acre-feet.
- The main tributary to the Colorado River, the Little Colorado River has a mean annual flow of 162,000 acre-feet near Cameron. As shown on Figure 6.1-4, there is significant variability in year to year flow.

Flood ALERT Equipment

- Refer to Table 6.1-3.
- As of October 2005 there were two stations in the basin, one is a precipitation/ stage station and the other is a repeater/precipitation station.

Reservoirs and Stockponds

- Refer to Table 6.1-4.
- The basin contains 12 large reservoirs. The largest is Dogtown with a maximum storage capacity of 1,390 acre-feet.
- The most common use of the large reservoirs is for fire protection or as a stock or farm pond. Dogtown, Kaibab and Cataract Reservoirs provide water supply for the City of Williams.
- Most large reservoirs with a 50-acre surface area or greater in this basin are either dry or

intermittent lakes.

- Surface water is stored or could be stored in 45 small reservoirs in the basin.
- There are 757 registered stockponds in this basin.

Runoff Contour

- Refer to Figure 6.1-5.
- Average annual runoff is highest, two inches per year or 106 acre-feet per square mile, in the southeastern portion of the basin and decreases to 0.1 inches, or five acre-feet per square mile, along most of the Colorado River.

Figure 6.1-4 Annual flows (acre-feet) at Little Colorado River near Cameron, water years 1948-2006 (Station #9402000)

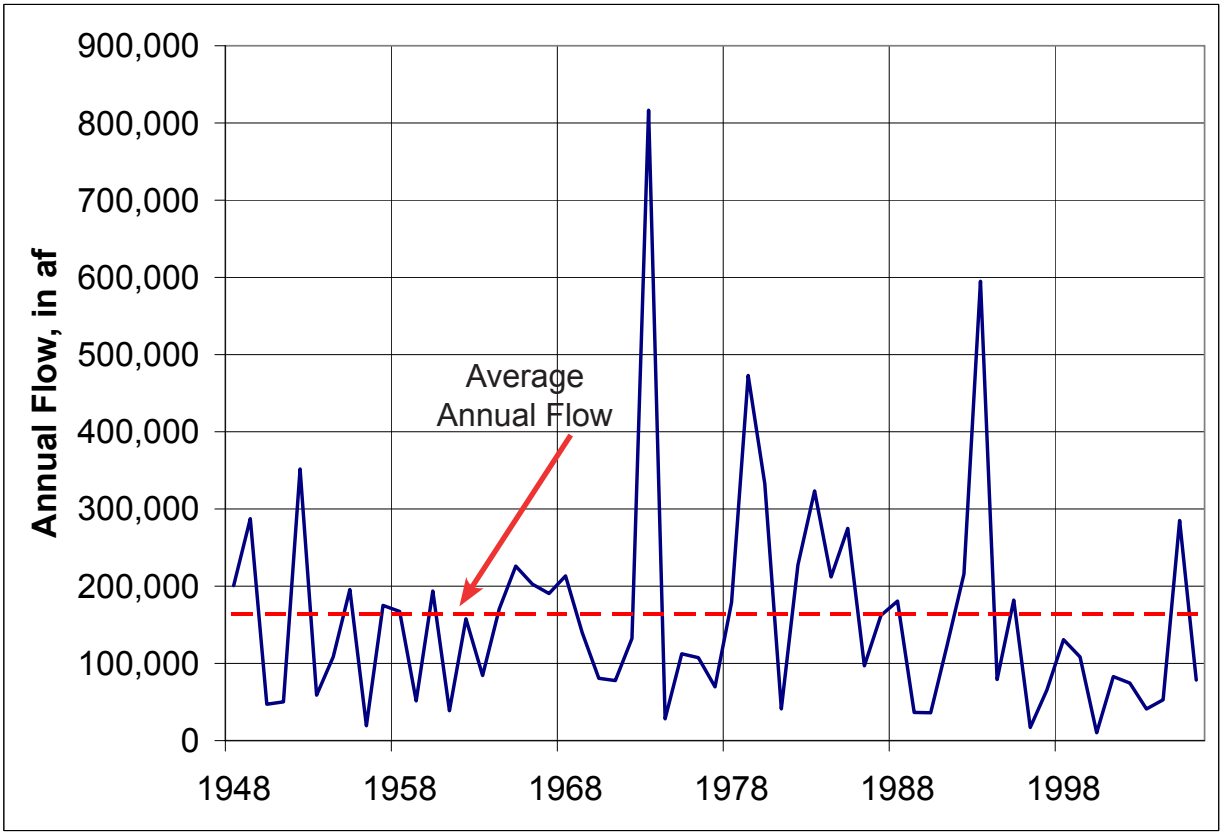


Table 6.1-2 Streamflow Data for the Coconino Plateau Basin

Station Number	USGS Station Name	Drainage Area (in mi^2)	Mean Basin Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow/Year (in acre-feet)				Years of Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
9401500	Moenkopi Wash near Cameron	2,662	NA	10/1953-1/1965 (discontinued)	6	3	78	13	3,671 (1960)	6,936	9,981	19,909 (1963)	11
9402000	Little Colorado River near Cameron	26,091	6,300	6/1947-current (real time)	34	26	27	14	10,215 (2000)	138,315	162,519	816,449 (1973)	55
9402300	Little Colorado River above the mouth near Desert View	26,578	NA	5/1990 - current (real time)	No statistics run; less than 3 years of data								
9402450	Cottonwood Spring above confluence with Cottonwood Creek near Grand Canyon	NA	NA	10/1994-1/2003 (discontinued)	No statistics run; less than 3 years of data								
9403000	Bright Angel Creek near Grand Canyon	101	7,390	10/1923-4/1993 (discontinued)	18	50	16	16	11,366 (1972)	21,502	25,165	65,737 (1941)	51
9403043	Hermit Creek above Tonto Trail near Grand Canyon	NA	NA	10/1994-1/2003 (discontinued)	No statistics run; less than 3 years of data								
9404110	Havasu Creek at Supai	2,600	NA	9/1995-current	25	25	26	24	46,985 (1996)	47,421	47,514	47,930 (1998)	7
9404112	Havasu Creek above Havasu Falls near Supai	2,898	NA	9/1995-6/2000 (discontinued)	25	24	27	25	39,022 (1996)	39,964	40,090	41,412 (1998)	4
9404115	Havasu Creek above the mouth near Supai	2,811	NA	11/1990-current	25	24	27	24	50,474 (2002)	52,176	52,574	55,471 (1992)	4
9404120	Colorado River above National Canyon near Supai	143,279	NA	7/1983-4/1996 (discontinued)	24	22	32	22	8,246,104 (1990)	8,542,935	8,526,042	8,789,087 (1991)	3
9404200	Colorado River above Diamond Creek near Peach Springs	144,660	NA	8/1983-current (real time)	25	25	28	23	8,450,947 (2002)	9,254,765	10,426,177	15,974,970 (1997)	13
9404208	Diamond Creek near Peach Springs	280	NA	5/1993-current (real time)	29	18	31	22	2,209 (2002)	2,629	2,967	5,026 (1999)	9

Sources: USGS NWIS, USGS 1998 and USGS 2003.

Notes:
NA = Not available
Statistics based on Calendar Year
Annual Flow statistics based on monthly values
Annual Flow/Year statistics were only completed for those gages that had at least 3year of 12 month records.
Summation of Average Annual Flows may not equal 100 due to rounding.
Period of record may not equal Year of Record used for annual Flow/Year statistics due to only using years with a 12 month record

Table 6.1-3 Flood ALERT Equipment in the Coconino Basin

Station ID	Station Name	Station Type	Install Date	Responsibility
3920	City Dam in Williams	Precipitation/Stage	9/23/2005	ADWR
7540	Manzanita Repeater	Repeater/Precipitation	NA	Mohave County FCD

Notes:
ADWR = Arizona Department of Water Resources
FCD = Flood Control District
NA = Information is not available at this time

Table 6.1-4 Reservoirs and Stockponds in the Coconino Plateau Basin

A. Large Reservoirs (500 acre-feet capacity and greater)

MAP KEY	RESERVOIR/LAKE NAME *(Name of dam, if different)*	OWNER/OPERATOR	MAXIMUM STORAGE (AF)	USE[1]	JURISDICTION
1	Dogtown	City of Williams	1,390	F,R,S	State
2	Kaibab	City of Williams	967	F,R,S	State
3	Long Point	AZ Land Dept/ Babbitt Ranches	946[2]	P	State
4	Cataract *(West Cataract Creek)*	City of Williams	860[2]	R,S	State
5	Gonzales[3,5]	Private	776	O	Landowner

Source: U.S. Army Corps of Engineers 2005, City of Williams 2007

B. Other Large Reservoirs (50 acre surface area or greater)[4]

MAP KEY	RESERVOIR/LAKE NAME *(Name of dam, if different)*	OWNER/OPERATOR	MAXIMUM SURFACE AREA (acres)	USE[1]	JURISDICTION
6	Davenport	Kaibab NF	252	P	Federal
7	Red Lake Tank[5]	Kaibab NF	200	P	Federal
8	Dog Knob[6]	Kaibab NF	178	P	Federal
9	Stone[5]	Kaibab NF	153	P	Federal
10	Tule[6]	Havasupai Tribe	108	P	Tribal
11	Laguna[5]	Hualapai Tribe	89	P	Tribal
12	Smoot	Private	50	P	Landowner

C. Small Reservoirs (greater than 15 acre-feet and less than 500 acre-feet capacity)

Total number: 8
Total maximum storage: 892 acre-feet

D. Other Small Reservoirs (between 5 and 50 acres surface area)[3]

Total number: 37
Total surface area: 521 acres

E. Stockponds (up to 15 acre-feet capacity)

Total number: 757

[1] F=fish & wildlife pond; O=Other; P=fire protection, stock or farm pond; R=recreation; S=water supply
[2] Normal capacity < 500acre-feet
[3] The height of this dam is less than 6 feet. It is not regulated by State or Federal government.
[4] Capacity data not available to ADWR
[5] Intermittent lake
[6] Dry

Stream Data Source: ALRIS, 2005

Figure 6.1-5
Coconino Plateau Basin
Surface Water Conditions

6.1.5 Perennial/Intermittent Streams and Major Springs in the Coconino Plateau Basin

Major and minor springs with discharge rates and date of measurement, and the total number of springs in the basin are shown in Table 6.1-5. The locations of major springs and perennial and intermittent streams are shown on Figure 6.1-6. A description of data sources and methods for intermittent and perennial reaches is found in Volume 1, Section 1.3.16. A description of spring data sources and methods is found in Volume 1, Section 1.3.14.

- Numerous perennial streams are located along and in the vicinity of the northern basin boundary. All perennial reaches, aside from the Colorado River, are short, spring fed and flow into the Colorado River.
- Intermittent streams are found along the Colorado River and in the vicinity of Williams. The Little Colorado River is intermittent for most of its length in the basin.
- There are 28 major springs with a measured discharge of 10 gallons per minute (gpm) or greater at any time.
- Listed discharge rates may not be indicative of current conditions. Many of the measurements were taken during or prior to 1994.
- Most springs are located along the Colorado River. The greatest discharge rate, 101,600 gpm, was measured at the Blue springs area which support perennial flow in the Little Colorado River.
- Springs with measured discharge of 1 to 10 gpm are not mapped but coordinates are given in Table 6.1-5B. There are 27 minor springs in this basin.
- The total number of springs, regardless of discharge, identified by the USGS varies from 71 to 80, depending on the database reference.

Table 6.1-5 Springs in the Coconino Plateau Basin

A. Major Springs (10 gpm or greater):

Map Key	Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
		Latitude	Longitude		
1	Blue-springs area[2]	360700	1114137	101,600	1950-1993
2	Havasu	361303	1124112	28,500	8/23/1994
3	Artesian at River Mile 182	361025	1130711	2,230	5/28/1995
4	Hawaii	360414	1121305	398	4/11/2001
5	Warm (multiple)	361148	1130459	390	5/28/1995
6	Hermit Creek	360417	1121307	328	11/21/2002
7	Diamond	354248	1131538	251	5/19/1993
8	Diamond Creek	354311	1131352	244	6/9/1994
9	Unnamed[3,4]	361627	1124331	200	5/20/1950
10	Hance at campground[3]	360106	1115732	179	4/8/2001
11	Three Springs[3]	355308	1131829	170	3/24/2004
12	Blue Mountain Canyon[3]	354302	1131747	100	6/9/1994
13	Unnamed[3,4]	361535	1124226	100	5/20/1950
14	Beecher	360957	1130802	90	5/28/1995
15	West Elk	352248	1115917	70	6/6/1979
16	Granite Spring Canyon[3]	354855	1131833	57[5]	5/19/1993
17	Matkatamiba	362032	1124017	54	11/10/2003
18	East Elk	352236	1115912	47	6/6/1979
19	Garden Creek below Tonto Trail	360440	1120740	45	11/9/2000
20	National Canyon (total flow)	361518	1125239	33	10/21/1997
21	Colorado River Mile 140[3]	362338	1123516	25[6]	6/22/1950
22	Newman	352418	1115149	20	6/5/1979
23	Monument[3]	360356	1121032	18	11/21/2002
24	Unnamed	362837	1115042	15	4/29/1976
25	Granite Park[3]	355750	1131836	14	10/13/1993
26	Monument Creek[3]	360455	1121110	13	8/23/2003
27	Pipe Creek	360409	1120557	12[5]	12/7/2000
28	Unnamed[2,3]	361627	1124226	10	5/20/1950

Table 6.1-5 Springs in the Coconino Plateau Basin (cont'd.)

B. Minor Springs (1 to 10 gpm):

Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
	Latitude	Longitude		
Fern	361524	1124204	8	8/24/1994
Boucher east	360609	1121414	8	4/12/2001
Tappen	355129	1112633	8	9/26/2001
Royal Arch	361119	1122715	7	3/23/2002
Mohawk Canyon	361246	1125815	5	5/19/2002
Cottonwood	360128	1115912	5	11/29/2000
Miner's	360059	1115817	5[7]	11/20/1981
Burro	360436	1120604	4	4/8/2001
Honga above mouth	361237	1130257	4[7]	10/10/1993
Pipe	360415	1120606	4	5/22/2000
Raspberry	352030	1113852	4	8/30/1978
222 Mile Canyon	354815	1131920	3	5/31/1995
Big	355959	1131227	3	5/20/1993
Unnamed	355502	1131959	2	10/13/1993
Unnamed	355502	1131959	2	5/31/1995
Red Canyon	360020	1115604	2	6/3/2002
Pumphouse	360440	1120731	2[7]	11/19/2001
Grapevine East	360232	1120042	2[7]	11/29/2000
Grapevine Main	360039	1120009	1	11/15/2001
Forester Canyon 2	361403	1123142	1	1/20/2002
National Canyon	361346	1125215	1	11/6/2002
Salt Creek	360436	1120940	1	4/1/2001
Clover	351351	1121211	1	8/5/1976
Sapphire	360711	1121846	1	10/23/2003
Horn	360450	1120836	1	11/22/2002
Hockey Puck	355602	1131032	1	6/9/1994
Unnamed[3,4]	351509	113524	1	11/1950

C. Total number of springs, regardless of discharge, identified by USGS (see ALRIS, 2005 and NHD, 2006): 71 to 80

Notes:

[1] Most recent measurement identified by ADWR

[2] Discharge is average for all springs in the lower 13 mile reach of the Little Colorado River, date measured varies by spring

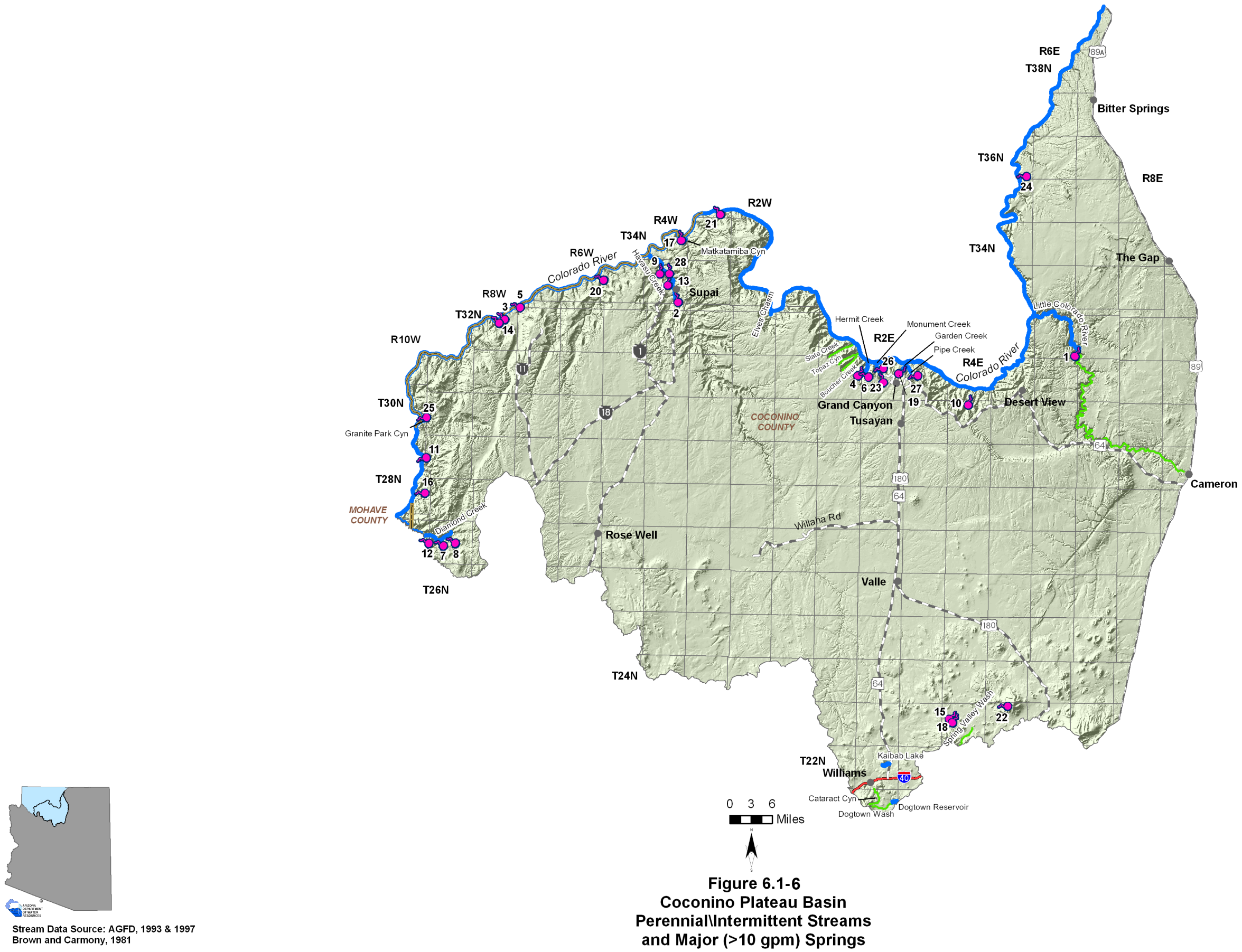
[3] Spring is not displayed on current USGS topo maps

[4] Location approximated by ADWR

[5] Spring flow is highly variable. Earlier measurement is shown, most recent measurement < 10gpm

[6] Average discharge

[7] Spring flow is highly variable. Earlier measurement is shown, most recent measurement < 1gpm



Stream Data Source: AGFD, 1993 & 1997
Brown and Carmony, 1981

Figure 6.1-6
Coconino Plateau Basin
Perennial\Intermittent Streams
and Major (>10 gpm) Springs

6.1.6 Groundwater Conditions of the Coconino Plateau Basin

Major aquifers, well yields, estimated water in storage, number of index wells and date of last water-level sweep are shown in Table 6.1-6. Figure 6.1-7 shows aquifer flow direction and water-level change between 1990-1991 and 2003-2004. Figure 6.1-8 contains hydrographs for selected wells shown on Figure 6.1-7. Figure 6.1-9 shows well yields in four yield categories. A description of aquifer data sources and methods is found in Volume 1, Section 1.3.2. A description of well data sources and methods, including water-level changes and well yields, is found in Volume 1, Section 1.3.19.

Major Aquifers

- Refer to Table 6.1-6 and Figure 6.1-7.
- Major aquifers in the basin include volcanic rocks, basin fill and sedimentary rocks (C- and R-aquifers and Moenkopi and Chinle Formations).
- Almost all of the basin geology consists of consolidated crystalline and sedimentary rock.
- Flow direction is toward the Little Colorado River in the eastern portion of the basin and generally toward the west in the western portion of the basin.

Well Yields

- Refer to Table 6.1-6 and Figure 6.1-9.
- As shown on Figure 6.1-9, well yields in this basin are generally less than 100 gallons per minute (gpm). However, there are several relatively high yield wells owned by the City of Flagstaff in the southeast part of the basin.
- One source of well yield information, based on 16 reported wells, indicates that the median well yield in this basin is 45.5 gpm.

Water Level

- Refer to Figure 6.1-7. Water levels are shown for wells measured in 2003-2004.
- The Department annually measures two index wells in this basin (see Figure 6.1-8, hydrographs B and C).
- All water level information is from the southern portion of the basin. The deepest water level shown on the map is 2,518 feet at Tusayan. Although not shown on the map, there are three wells with a depth to water of over 2,700 feet in the vicinity of Williams. The shallowest water level shown on the map is three feet in a perched aquifer south of Williams.
- Hydrographs corresponding to selected wells shown on Figure 6.1-7 but covering a longer time period are shown in Figure 6.1-8.

Table 6.1-6 Groundwater Data for the Coconino Plateau Basin

Basin Area, in square miles:	5,812	
Major Aquifer(s):	**Name and/or Geologic Units**	
	Volcanic Rock	
	Basin Fill	
	Sedimentary Rock (Moenkopi and Chinle Formations)	
	Sedimentary Rock (C Aquifer)	
	Sedimentary Rock (R Aquifer)	
Well Yields, in gal/min:	44 (1 well measured)	Measured by ADWR and/or USGS
	Range 4-1,500 Median 45.5 (16 reported)	Reported on registration forms for large (> 10-inch) diameter wells
	Range 30-100	ADWR (1990)
	Range 0-10	USGS (1994)
Estimated Natural Recharge, in acre-feet/year:	N/A	
Estimated Water Currently in Storage, in acre-feet:	3,000,000*	Montgomery et al, 2000
	N/A	Arizona Water Commission (1975)
Current Number of Index Wells:	2	
Date of Last Water-level Sweep:	1964 (5 wells measured)	

* Estimated by ADWR based on the assumptions by Montgomery et al (2000) of an average specific yield (drainage porosity) of 0.1%. Montgomery at al's study area was larger than and covered most of the Coconino Plateau Basin.
N/A = Not Available

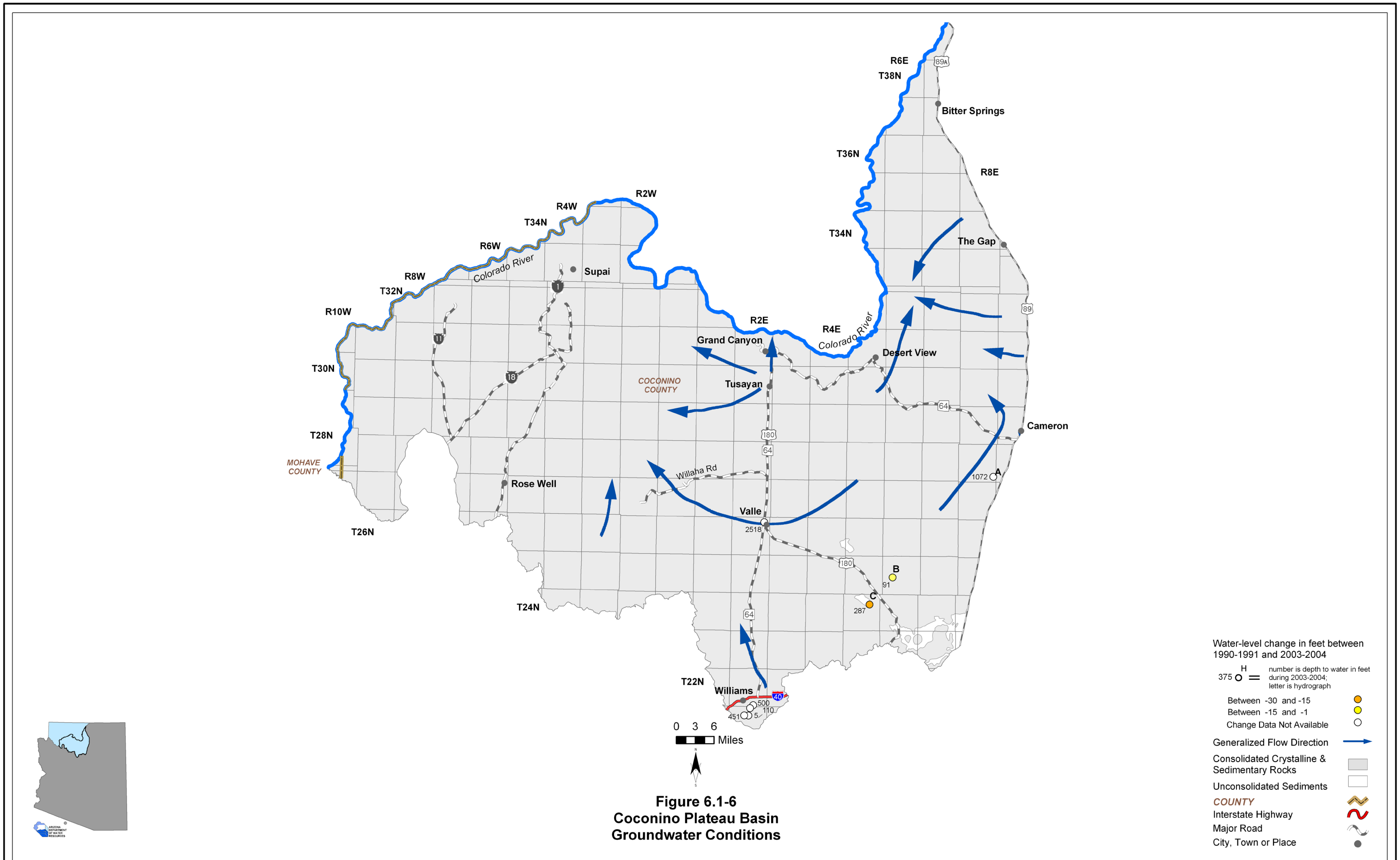


Figure 6.1-6
Coconino Plateau Basin
Groundwater Conditions

Figure 6.1-8
Coconino Plateau
Hydrographs Showing Depth to Water in Selected Wells

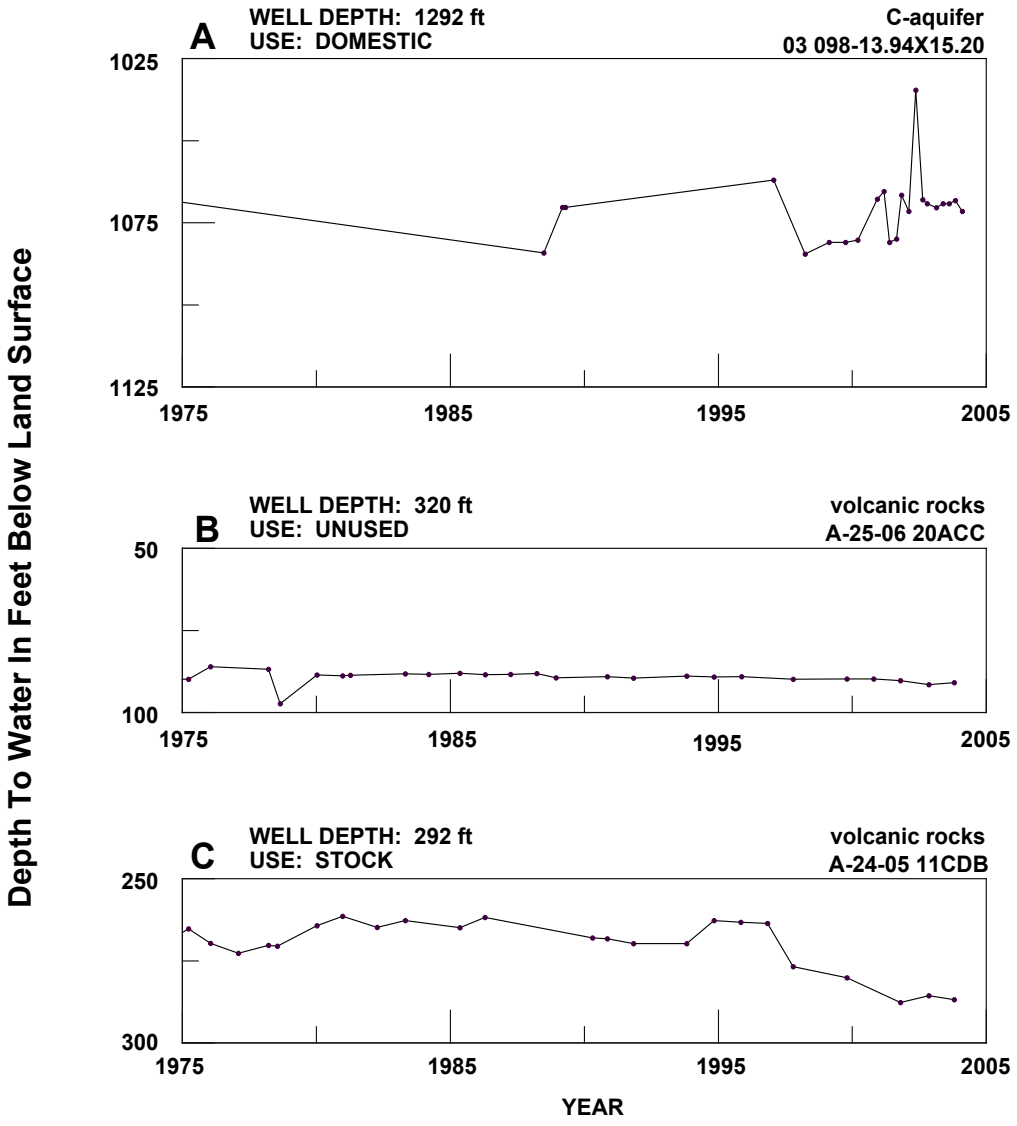


Figure 6.1-9
Coconino Plateau Basin
Well Yields

6.1.7 Water Quality of the Coconino Plateau Basin

Wells, springs and mine sites with parameter concentrations that have equaled or exceeded drinking water standard(s), including location and parameter(s) are shown in Table 6.1-7A. Impaired lakes and streams with site type, name, length of impaired reach, area of impaired lake, designated use standard and parameter(s) exceeded is shown in Table 6.1-7B. Figure 6.1-10 shows the location of water quality occurrences keyed to Table 6.1-7. A description of water quality data sources and methods is found in Volume 1, Section 1.3.18. Not all parameters were measured at all sites; selective sampling for particular constituents is common.

Wells, Springs and Mines

- Refer to Table 6.1-7A.
- Twenty-two wells or springs have parameter concentrations that have equaled or exceeded drinking water standards.
- The parameter most frequently equaled or exceeded in the sites measured was arsenic.
- Other parameters equaled or exceeded include total dissolved solids, radionuclides, thallium, nitrates, mercury and lead.

Lakes and Streams

- Refer to Table 6.1-7B.
- The water quality standard for suspended sediment concentration was exceeded in one 28-mile stream reach, the Colorado River from Parashant Canyon to Diamond Creek. This impaired reach also forms part of the border with the Shivwits Plateau Basin.
- This reach is not part of the ADEQ water quality improvement effort called the Total Maximum Daily Load (TMDL) Program at this time.

Effluent Dependent Reaches

- See Figure 6.1-10
- There is one effluent dependent reach in this basin, which receives effluent from the South Rim Wastewater Treatment Plant.

Table 6.1-7 Water Quality Exceedences in the Coconino Plateau Basin[1]

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded Drinking Water Standard (DWS)[2]
		Township	Range	Section	
1	Spring	33 North	5 East	NA	TDS
2	Spring	32 North	7 East	31	TDS
3	Spring	31 North	2 East	15	Rad
4	Well	31 North	9 East	33	Tl
5	Spring	30 North	4 East	4	As
6	Spring	29 North	9 East	15	NO3
7	Well	25 North	2 East	27	TDS
8	Spring	33 North	4 West	11	Pb
9	Well	33 North	4 West	22	As
10	Spring	33 North	4 West	35	As, Pb
11	Spring	33 North	7 West	31	As
12	Spring	33 North	8 West	36	As, Hg
13	Spring	33 North	8 West	36	As, Hg
14	Spring	32 North	8 West	22	As
15	Spring	30 North	10 West	25	As
16	Spring	29 North	9 West	19	As
17	Spring	29 North	10 West	14	As, TDS
18	Spring	29 North	10 West	14	As
19	Spring	29 North	10 West	25	As
20	Well	27 North	6 West	12	Pb
21	Spring	27 North	9 West	15	As
22	Spring	27 North	10 West	24	As

B. Lakes and Streams

Map Key	Site Type	Site Name	Length of Impaired Stream Reach (in miles)	Area of Impaired Lake (in acres)	Designated Use Standard[3]	Parameter(s) Exceeding Use Standard[2]
a	Stream	Colorado River (Parashant Canyon to Diamond Creek)	284	NA	A&W	SSC

Notes:

NA = Not Applicable

[1] Water quality samples collected between 1951 and 1994.

[2] As = Arsenic
Pb = Lead
Hg = Mercury
NO3 = Nitrate/nitrite
Rad = One or more of the following radionuclides - Gross Alpha, Gross Beta, Radium, and Uranium
Tl = Thallium
TDS = Total Dissolved Solids
SSC = Suspended Sediment Concentration

[3] A&W = aquatic and wildlife

[4] Total length of the impaired reach. This reach forms a portion of the border with the Shivwits Plateau Basin.

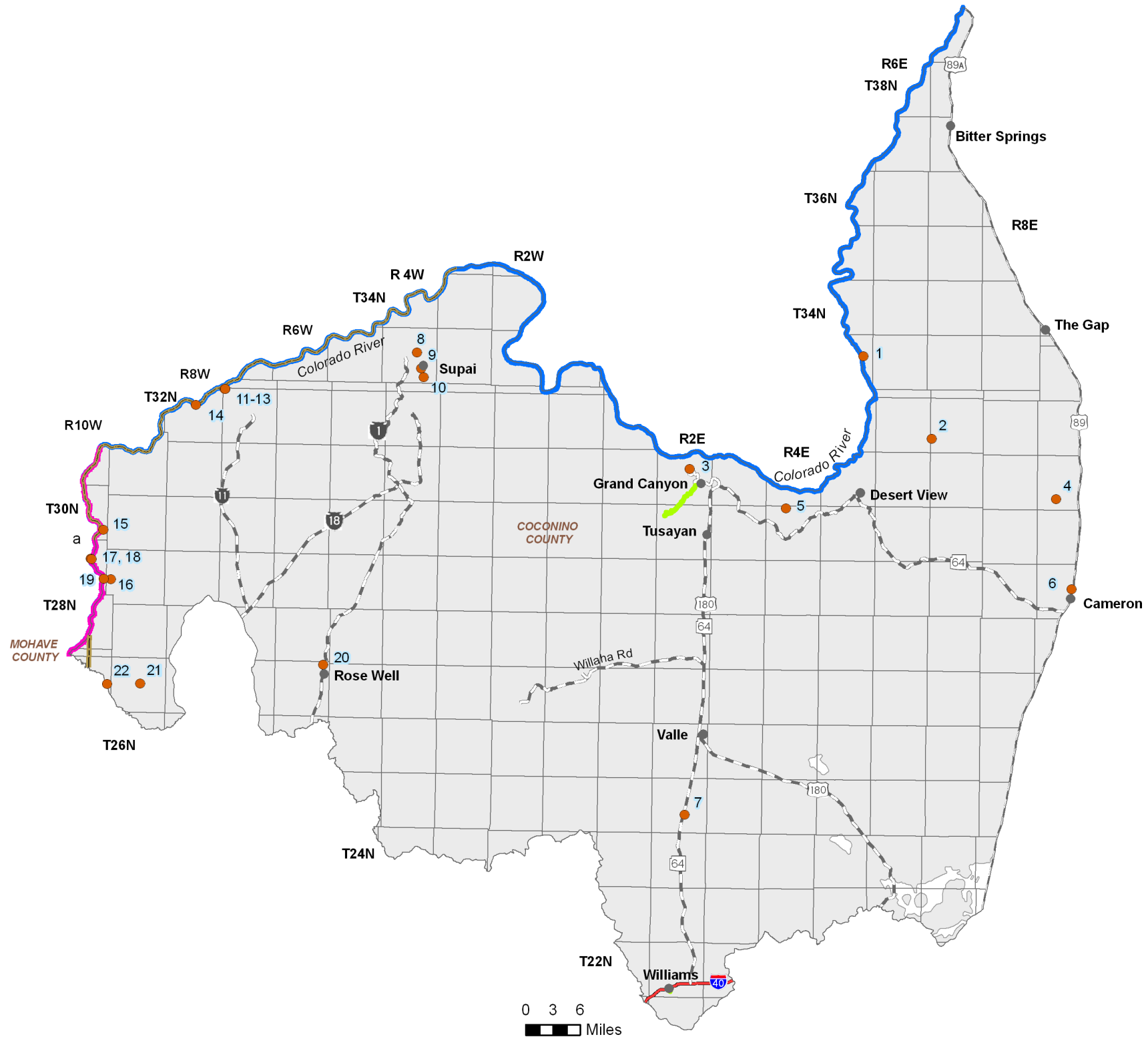


Figure 6.1-10
Coconino Plateau Basin
Water Quality Conditions

6.1.8 Cultural Water Demands in the Coconino Plateau Basin

Cultural water demand data including population, number of wells and the average well pumpage and surface water diversions by the municipal, industrial and agricultural sectors are shown in Table 6.1-8. Effluent generation including facility ownership, location, population served and not served, volume treated, disposal method and treatment level is shown in Table 6.1-9. Figure 6.1-11 shows the location of demand centers. A description of cultural water demand data sources and methods is found in Volume 1, Section 1.3.5. More detailed information on cultural water demands is found in Section 5.0.7.

Cultural Water Demands

- Refer to Table 6.1-8 and Figure 6.1-11.
- Population in this basin increased from 6,977 in 1980 to 9,164 in 2000 and is projected to reach 16,589 by 2050. This is the most populous basin in the planning area.
- All cultural water use in this basin is for municipal demand. Municipal demand centers include Williams, Tusayan, Grand Canyon Village, Valle, Supai and Cameron.
- Groundwater demand is small and has remained relatively constant from 1971-2003. In 2000 the City of Williams started using groundwater because surface water supplies were unavailable due to drought. Groundwater use increased to 344 acre-feet in 2003.
- Data on municipal surface water use prior to 1991 is not available. From 1991-2003 municipal surface water use decreased from 500 acre-feet per year to 350 acre-feet per year due to surface water shortages in Williams.
- As of 2003 there were 152 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 17 wells with a pumping capacity of more than 35 gallons per minute.

Effluent Generation

- Refer to Table 6.1-9.
- There are eight wastewater treatment facilities in this basin.
- Information on population served was available for two facilities and information on effluent generation was available for five facilities. These facilities serve almost 3,700 people and generate over 1,800 acre-feet of effluent per year.
- Three facilities discharge to watercourses, two discharge to an evaporation pond, four discharge for irrigation, one discharges to a golf course, two discharge for municipal uses such as toilet flushing and one discharges to an unlined impoundments that recharge the aquifer.

Table 6.1-8 Cultural Water Demands in the Coconino Plateau Basin [1]

Year	Recent (Census) and Projected (DES) Population	Number of Registered Water Supply Wells Drilled		Average Annual Demand (in acre-feet)						Data Source
				Well Pumpage			Surface-Water Diversions			
		Q ≤ 35 gpm	Q > 35 gpm	Municipal	Industrial	Irrigation	Municipal	Industrial	Irrigation	
1971		101[2]	10[2]	<500			NR			ADWR (1994)
1972										
1973										
1974										
1975										
1976				<500			NR			
1977										
1978										
1979										
1980	6,977									
1981	7,051	9	0	<500			NR			
1982	7,126									
1983	7,200									
1984	7,275									
1985	7,349									
1986	7,424	19	3	<500			NR			
1987	7,498									
1988	7,573									
1989	7,647									
1990	7,722									
1991	7,866	15	3	<300	NR	NR	500	NR	NR	USGS (2005) ADWR (2005)
1992	8,010									
1993	8,155									
1994	8,299									
1995	8,443									
1996	8,587	2	0	<300	NR	NR	600	NR	NR	
1997	8,731									
1998	8,876									
1999	9,020									
2000	9,164									
2001	9,282	6	1	300	NR	NR	350	NR	NR	
2002	9,401									
2003	9,519									
2010	10,346									
2020	11,793									
2030	13,187									
2040	14,753									
2050	16,589									
ADDITIONAL WELLS: [3]		**10**								
WELL TOTALS:		**152**	**17**							

[1] Does not include evaporation losses from stockponds and reservoirs.

[2] Includes all wells through 1980.

[3] Other water-supply wells are listed in the ADWR Well Registry for this basin, but they do not have completion dates. These wells are summed here.

NR - Not reported

Note: Surface water diverted in the Kanab Plateau Basin is delivered to the Coconino Plateau Basin for use at the Grand Canyon South Rim. This diversion is not included in the table.

Table 6.1-9 Effluent Generation in the Coconino Plateau Basin

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet)	Disposal Method								Current Treatment Level	Population Not Served	Year of Record
					Water-course	Evaporation Pond	Irrigation	Golf Course	Municipal Reuse	Wildlife Area	Discharged to Another Facility	Infiltration Basins			
Cameron WWTP	Navajo Tribe	Cameron	NA	NA		X							NA		2004
Desert View WWTP	National Park Service	Campground	NA	11		Lagoon							NA		2004
Grand Canyon Inn	Private	Hotel	NA	NA			X						NA		
Grand Canyon Valle Airport WWTP	Private	Valle	NA	NA			X						NA		
South Rim WWTP	National Park Service	Park	NA	448	Bright Angel Wash		X		X				Tertiary	NA	2004
Supai Village Sewer System	Havasupai Tribe	Supai	1,000	56								X	Secondary	NA	2001
Tusayan WWTP	South Grand Canyon Sanitary District	Tusayan	NA	68	Coconino Wash		X		X						2004
Williams WWTP	Williams	Williams	2,690	1,138	Cataract Creek			Elephant Rock					Secondary	NA	2000
Total			3,690	1,721											

NA: Data not currently available to ADWR
WWTP: Waste Water Treatment Plant

Primary Data Source: USGS National Gap Analysis Program, 2004

Figure 6.1-11
Coconino Plateau Basin
Cultural Water Demand

Demand Centers

- M&I - High Intensity
- M&I - Low Intensity
- Indian Reservation

COUNTY
Interstate Highway
Major Road
City, Town or Place

6.1.9 Water Adequacy Determinations in the Coconino Plateau Basin

Water adequacy determination information including the subdivision name, location, number of lots, adequacy determination, reason for the inadequacy determination, date of determination and subdivision water provider are shown in Table 6.1-10. Figure 6.1-12 shows the locations of subdivisions keyed to the Table. A description of the Water Adequacy Program is found in Volume 1, Appendix A. Adequacy determination data sources and methods are found in Volume 1, Sections 1.3.1.

Water Adequacy Reports

- See Table 6.1-10
- All subdivisions receiving an adequacy determination are in the vicinity of Williams. Twenty-seven water adequacy determinations for 1,194 lots have been made in this basin through May, 2005, all were determinations of inadequacy.
- The most common reason for a determination of inadequacy was because the distribution system was insufficient to meet demands or the applicant proposed water hauling. The next most common reason was insufficient water supply.

Table 6.1-10 Adequacy Determinations in the Coconino Plateau Basin[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at Time of Application
			Township	Range	Section						
1	Bally Mountain	Coconino	23 North	2 East	35	19		Inadequate	A3	01/14/93	Dry Lot Subdivision
2	Canyon Vista Ranch	Coconino	23 North	2 East	21	11	22-400438	Inadequate	A1, A2	12/05/00	Water Hauler
3	Chaparral Heights	Coconino	23 North	2 East	11	44		Inadequate	A2, A3	12/01/86	Dry Lot Subdivision
4	Highland Meadows at Williams # 1	Coconino	22 North	2 East	31	29	33-300384	Inadequate	A1	12/19/97	City of Williams
5	Highland Meadows at Williams # 2	Coconino	22 North	2 East	31	125	22-400042	Inadequate	A1	04/14/99	City of Williams
6	Highland Meadows at Williams # 3, Unit 1	Coconino	22 North	2 East	31	38	22-401256	Inadequate	D	04/26/04	City of Williams
7	Highland Meadows at Williams # 3, Unit 2	Coconino	22 North	2 East	31	39	22-401476	Inadequate	D	11/24/04	City of Williams
8	Howard Mesa Ranch Phase 2	Coconino	25 North	2 East	33	63	22-300584	Inadequate	A2	12/22/98	Dry Lot Subdivision
9	Howard Mesa Subdivision, Unit 2 & 3	Coconino	25 North	2 East	27, 35	75	22-400073	Inadequate	A2	05/14/99	Dry Lot Subdivision
10	Junipine Estates # 2, 3	Coconino	23 North	2 East	20	238		Inadequate	A2, A3	09/25/73	Dry Lot Subdivision
11	Kaibab Estates West	Coconino	22 North	2 East	11	9		Inadequate	A2, A3	02/03/92	Dry Lot Subdivision
12	Lake Kaibab Park	Coconino	23 North	2 East	15, 22, 23, 26	4		Inadequate	A3	04/08/91	D & D Water Company
13	Lake Kaibab Park # 1	Coconino	23 North	2 East	27, 35	14		Inadequate	A3	04/27/90	City of Williams
14	Lake Kaibab Park # 2	Coconino	23 North	2 East	27, 35	9		Inadequate	A3	04/06/94	A-1 Water Service
15	Lazy "E"	Coconino	22 North	2 East	30	NA		Inadequate	D	11/23/81	Dry Lot Subdivision
16	Lazy "E" # 2	Coconino	22 North	2 East	30, 31	18		Inadequate	A2, A3	07/03/86	Dry Lot Subdivision
17	Lazy "E" # 3	Coconino	22 North	2 East	31	39		Inadequate	A2, A3	06/18/93	Dry Lot Subdivision
18	Mason Commercial Center # 1	Coconino	22 North	2 East	28	4		Inadequate	A1, A2	08/26/93	City of Williams
19	Mi Casa	Coconino	22 North	2 East	33	5		Inadequate	A1	01/16/87	City of Williams
20	Mountain Shadows	Coconino	22 North	2 East	15, 22	14	22-400126	Inadequate	A2, A3	07/21/99	Dry Lot Subdivision
21	Pinecrest Estates	Coconino	22 North	2 East	29	51	22-300067	Inadequate	A1	11/20/95	City of Williams
22	Pinecrest Estates II	Coconino	22 North	2 East	29	84	22-400737	Inadequate	A1, A2	07/01/02	City of Williams
23	Red Lake Estates Unit I	Coconino	23 North	2 East	1	120	22-400401	Inadequate	A2, A3	10/30/00	A-1 Water Service
24	Red Lake Estates, Unit II	Coconino	23 North	2 East	1	23	22-400932	Inadequate	A2, A3	05/05/03	A-1 Water Service
25	Red Lake Mountain Ranch	Coconino	23 North	2 East	3	54		Inadequate	A3	03/21/89	Dry Lot Subdivision

Table 6.1-10 Adequacy Determinations in the Coconino Plateau Basin (cont'd)[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at Time of Application
			Township	Range	Section						
26	Timber Canyon	Coconino	23 North	2 East	33	24	22-300249	Inadequate	A3	02/04/97	A-1 Water Service
27	Williams Pine Meadows Estates	Coconino	21 North	2 East	3, 4	41		Inadequate	A1	01/09/95	Dry Lot Subdivision

Notes:

[1]Each determination of the adequacy of water supplies available to a subdivision is based on the information available to ADWR and the standards of review and policies in effect at the time the determination was made. In some cases, ADWR might make a different determination if a similar application were submitted today, based on the hydrologic data and other information currently available, as well as current rules and policies.

[2] Prior to February 1995, ADWR did not assign file numbers to applications for adequacy determination.

[3] A. Physical/Continuous
1) Insufficient Data (applicant chose not to submit necessary information, and/or available hydrologic data insufficient to make determination)
2) Insufficient Supply (existing water supply unreliable or physically unavailable;for groundwater, depth-to-water exceeds criteria)
3) Insufficient Infrastructure (distribution system is insufficient to meet demands or applicant proposed water hauling)
B. Legal (applicant failed to demonstrate a legal right to use the water or failed to demonstrate the provider's legal authority to serve the subdivision)
C. Water Quality
D. Unable to locate records

NA = Not available to ADWR at this time

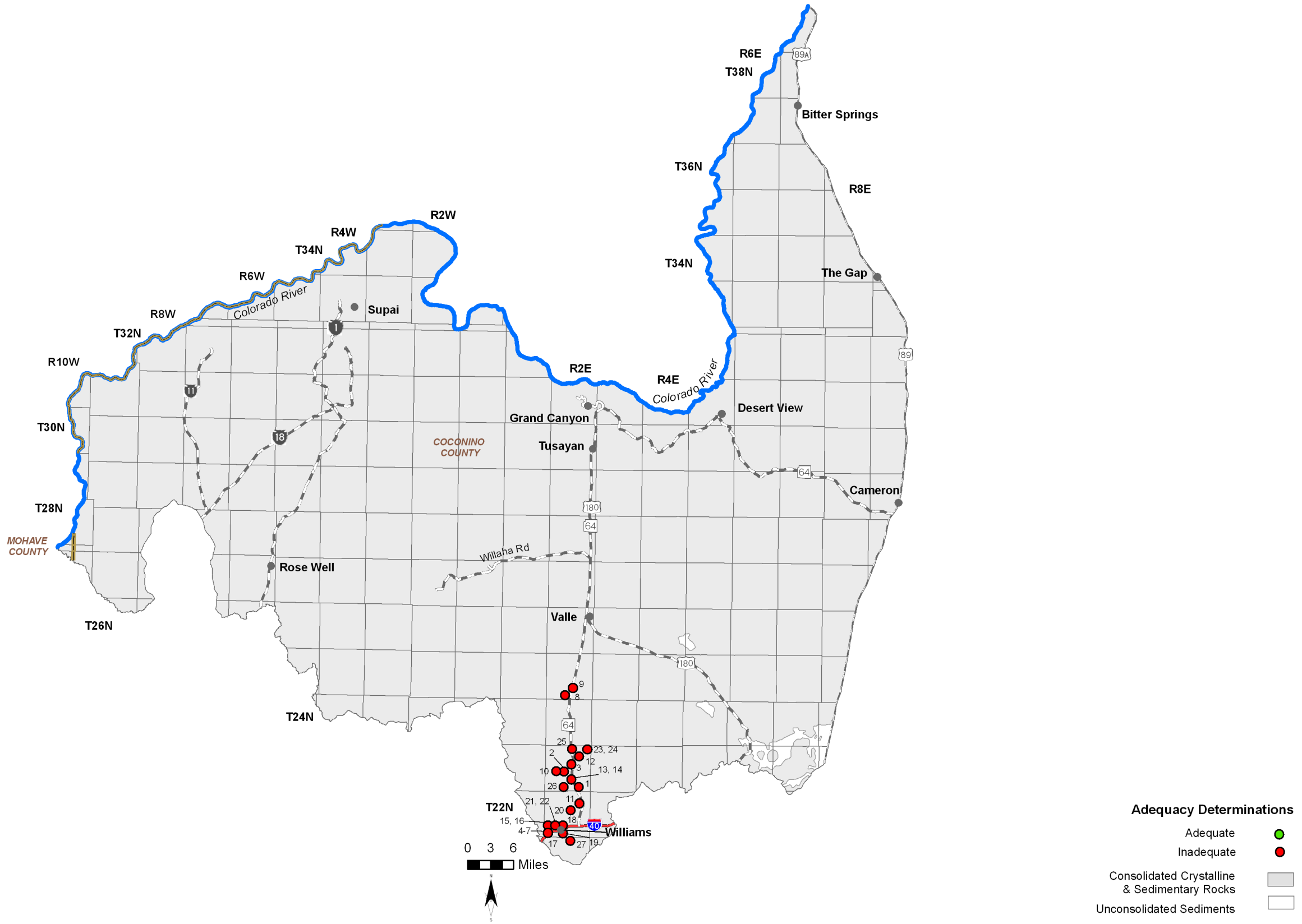


Figure 6.1-12
Coconino Plateau Basin
Adequacy Determinations

Coconino Plateau Basin
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Index to Section 6.0